MES Sp. z o.o.
Founded in 1993

The unrivalled ergospirometer

VO2max Tracker

100% of knowledge, passion and experience since 1993

The Unrivalled VO2max[Tracker] ergospirometer

In a field and in a laboratory

VO2max[Tracker] ergospirometer is a powerful portable system for cardiopulmonary exercise tests performed in a natural field (running, biking, rowing, sailing, etc.) during real training, competition or rehabilitation without stress devices (bicycle, treadmill). This system may also be used in a laboratory where the load can be set by plugged in: treadmill or cycle-ergometer. Ergospirometer exceeds the accuracy standards of both the American Thoracic Society and the European Respiratory Society. VO2max[Tracker] ergospirometer owes the perfect functionality to many years of experience of top class engineers-enthusiasts.

MES DV40 pneumotachograph head with digital converter of air flow

Ventilation measurement is performed with use of the unique MES DV40 pneumotachograph head patented by MES. Low resistance for flow, small dead space and low weight ensure patient conditions similar to the natural. No moving parts in the headpiece and a complete lack of sensitivity to humidity provide high accuracy and noise immunity. Sterilization of the entire headpiece gives a complete safety to tested subject. We introduced our new invention in the construction of the device which enables to eliminate air hoses, transmitting a differential pressure signal from our MES DV40 pneumotachograph to a sensor situated in the housing of the device. We developed and patented a flow measuring system with a digital converter of air flow. Its essence is to place pressure sensors with digital converter directly on the MES DV40 pneumotachograph head and transmitting the measured flow signal digital by means of a cable. We can say that we have the digital pneumotachograph now which will be a key element in all of our new devices. This solution also prevents a signal distortion during the transmission over long cables and increases the ease of movement of the subject's head. The measuring of CO_2 and O_2 concentration of exhaled air is based on two sensors with a quick response time less than 100 ms.

Technologically advanced design of VO2max[Tracker] ergospirometer

The technologically advanced design of the VO2max[Tracker] ergospirometer allows for application in cardiology, pulmonology, exercise physiology, sports medicine, cardiac rehabilitation, occupational medicine, intensive care, nutrition assessment and environmental medicine.

VO2max[Tracker] ergospirometr enables 24-hour continuous measurement and registration of ventilation and gas concentrations of CO_2 and O_2 by a breath-by-breath in the internal memory. The Unique headpiece constructed by MES used to measure ventilation, provides full comfort research through low flow resistance and insensitivity to moisture which allows you to perform tests even in tropical conditions. Eight values of selected parameters can be observed in real time on the screen, tablet or smart phone. Recorded results are transmitted to a computer for analysis, graphic presentation, printing and archiving. This system may also be operated in laboratories with direct preview of the measured values. Load can be set on cycle-ergometer, treadmill, or other devices. LAB option may be extended with 1-12 ECG leads with full analysis of values, preview in real time and storage.

VO2max[Tracker] ergospirometer weights only 280 g or 380 g if equipped with internal batteries (4 x AA 1,2 V), which guarantee 12 hours of continuous operation. VO2max[Tracker] can be placed at the back of the person tested in a specially developed mini-backpack.

Standard software range

- **Exercise test of respiratory system**

  measured values: t, VE, BF(RR), HR, TV(VT), FeO_2, $FeCO_2$, PEO_2, $PECO_2$, VO_2, VCO_2, $VE/VCO_2(EQCO_2)$, $VE/VO_2(EQO_2)$, RQ(RER), VD/VT, VC/VT, VO_2/kg, VO_2/kg/HR, MET, WATT(WORK), TTOT, TI, TE, TI/TE, TI/TTOT, TV/TE, PEF, PIF, BR, VET_SUM, O_2 kinetics ($T0{,}5VO_2peak$, $\tau 63\%\Delta VO_2$), O_2 oxygen deficit and debt parameters, cardiac output parameters: $C(a - v)O_2$, CO, SV, HI, SVI, CI are estimated noninvasively from oxygen uptake during exercise (by Wassermann Algorithm), indirect calorimetry.

- **Wireless heart rate recording system**

- solution of cardio-pulmonary exercise testing for swimmers

The possibility of development options

The basic range of ergospirometer configuration can be extended with additional measurement modules:

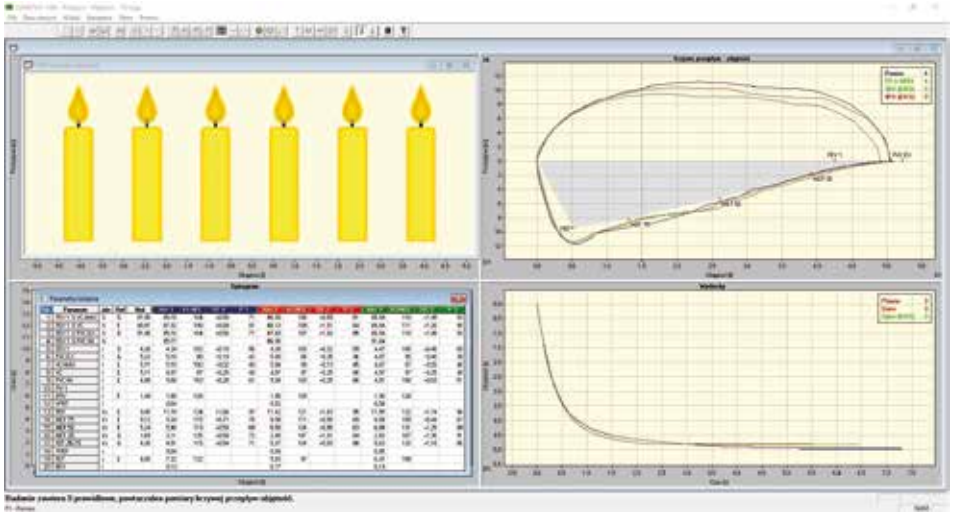
- full range of spirometry test meeting all ERS/ATS standards, with quality and correctness control

Slow spirometry:
VC, IC, ERV, TV, IRV, MV, BF

Flow/volume loop:
FEV0.5, FEV0.75, FEV1, FEV2, FEV3, FEV6, FVCex, PEF, MEF75, MEF50, MEF25, MEF@FRC, FEF75/85, FEF25/75, FEF 0.2-1.2, VPEF, TPEF, FET, TPEF%FET, MEF50%FVCex, FEV1%FVCex, FEV1%VC, FEV1/PEF, VCmax, FEV1%VCmax, FEV1%FEV3, FEV1%FEV6, BEV, BEV%FVCex, TC25/50, MTT, AEX, FVCin, FIV1, PIF, MIF50, FIT, TPIF, VPIF, TPIF%FIT, FEV1%FVCin, MEF50/MIF50, PEF/PIF, FEV1/FIV1, FET%FIT, TTOT

Maximal Voluntary Ventilation:
MVV, BF, BR

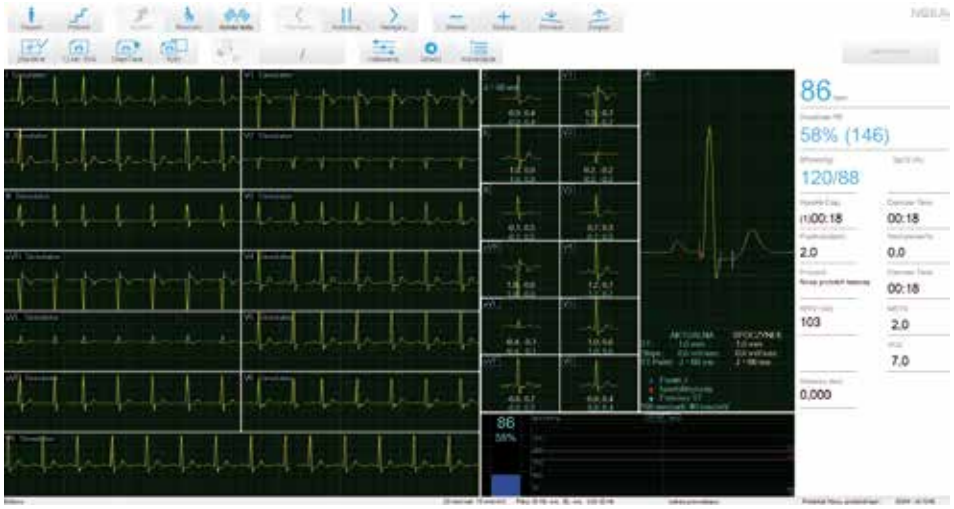
- software working with Android system for operating with smartphone/ tablet, allowing start and stop of the study, real--time preview of eight selected parameters, recording subjects to a file and entering of patient ID and its weight



- measurement of energy expenditure with evaluation of substrates oxidation

- module for measurement of energy expenditure for every respirator

- pulse-oximetry module with SpO_2 analysis
- telemetry unit with 2000 m range
- SBP/DBP noninvasive measurement module (in laboratory only)
- stress test system based on 12-lead ECG (in laboratory only)

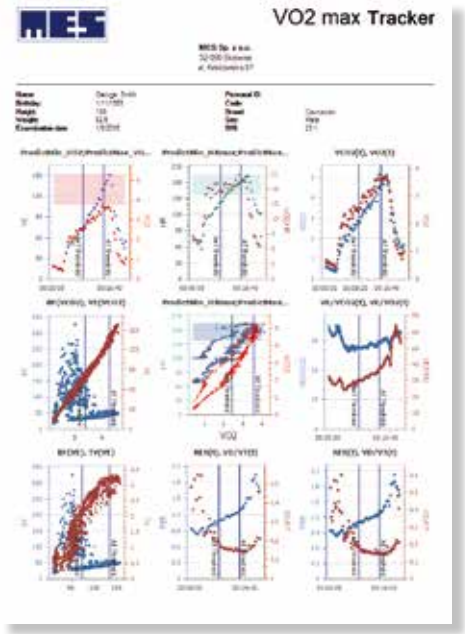


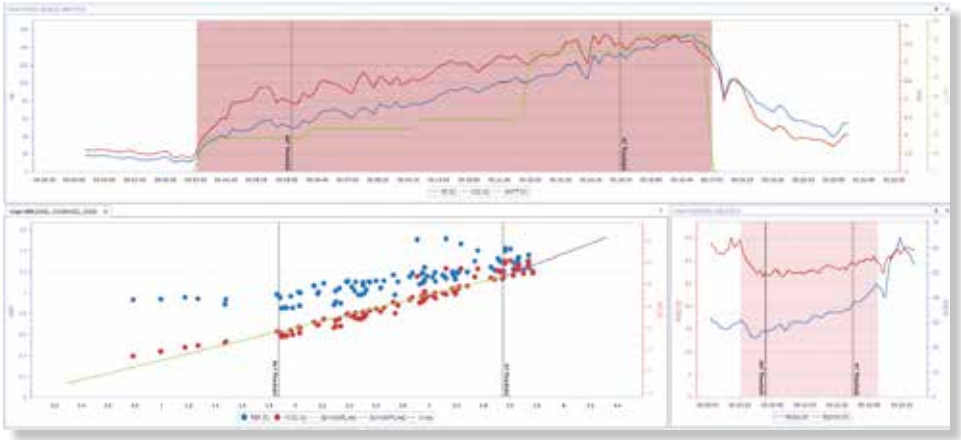
Powerful evaluation software with report generator

The software developed and manufactured by MES gives you virtually unlimited programming possibilities of measurement, its visualization, to define their own parameters and new predicted values. The user has a full set of standard reports and algorithms research. The software also gives you the ability to archive and complete courses of study results of multiple studies.

Report types:

- summary report provides data for a simple and easy interpretation
- ready-to-print pre-defined reports
- 9-chart Wasserman report with a single page report containing the 9 graphs and additional test results for an easy clinical interpretation





Advantages of our pneumotachograph head with digital converter (patents: nr 173767 and 230143)

- cable transmission of the measured flow signal
- headpiece cable connected with main unit
- pre-test calibration is not required
- high accuracy and resolution
- parameters do not change in the course of a test
- no moving elements
- sterile for each patient
- easily sterilizable as a whole
- lightweight
- small dead space
- low flow resistance
- no heating system
- insensitive to moisture
- life period - 10.000 tests

Manufacturer:

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VO2max Tracker Ergospirometer

Mobility and versatility VO2max Tracker ergospirometer

Features and advantages of ergospirometer:

- lightweight, portable measuring system suitable for field and laboratory operation
- breath-by-breath analysis method
- lightweight, low-resistant pneumotach headpiece MES DV40 without movable elements
- measuring air flow system with digital converter placed inside a coupler of the MES DV40 pneumotachograph close to headpiece
- air tubes for flow measurement eliminated and digital signal is sent by a cable to the main unit
- sensors for automatic ambient conditions measuring system built in a coupler of the MES DV40 pneumotachograph head
- HR receiver and ambient pressure sensor built inside the main unit
- automatic two-point calibration of gas analyzers
- displays real-time data and graphs in either pre-defined or user formats in laboratory (Bluetooth) and field (using Bluetooth and telemetry module)
- 24-hours record of a test in natural conditions
- internal (rechargeable) batteries (4 x AA 1,2V) can be changed during exercise
- easy transmission (Bluetooth or cable) of a field recorded test to a PC
- telemetry optional module with the 2000 m range
- standard and custom exercise protocols projects
- presentation of the measured values against the background of predicted values
- VO_2max determination
- add user defined parameters and predicted equations with custom based formulas
- automatic or manual determination of the aerobe, anaerobe and RCP thresholds
- O_2 kinetics feature automatically provides O_2 debt, O_2 deficit and time constant values
- indirect cardiac output by Wassermann Algorithm
- alternative methods of wireless pulse measurement (POLAR and/or ECG Stress Test in laboratory)
- ready-to-print pre-defined standard and customer reports
- 9-chart Wasserman report with a single page report containing the 9 graphs
- summary report provides data for a simple and easy interpretation
- advanced data elaboration with evaluation compatible with Wasserman Algorithm
- test data exporting to standard statistic programs
- software compatible with Microsoft Windows
- preview performance of 8 measured parameters in real time with a tablet or a smartphone
- automatic treadmills and/or bicycle ergometers control in the laboratory
- numerous upgrading options: full range of spirometry, 12-lead ECG Stress Test (in laboratory only), pulse-oximetry, module for measurement of energy expenditure for every respirator, solution of cardio-pulmonary exercise testing for swimmers, measurement of energy expenditure with evaluation of oxidation of energy substrates nutrition assessment etc.
- low maintenance costs and easy servicing
- providing free of charge upgrades during and after warranty period

Technical specifications of the VO2max[Tracker] ergospirometer

Flow rate and volume measurement:	
- measuring headpiece	MES DV40 (or DV40e)
- dead space	38 ml (or 20 ml)
- flow range	± 20 l/s
- flow resolution	1 ml/s
- usable flow resolution	10 ml/s
- volume measurement range	0 - ± 10 l (0 - 20 l)
- usable volume resolution	10 ml
- accuracy	< 2 %
- headpiece resistance	< 0,9 cm H_2O/l/s *(at 14 l/s flow rate)*
- ventilation range	300 l/min
Oxygen analyzer:	electrochemical cell
- measurement range	0 - 25 % (0 - 100 %)
- response time	t_{90} < 100 ms
- accuracy	± 0,01 %
- resolution	0,01 %
Carbon dioxide analyzer:	NDIR infrared absorption
- measurement range	0 - 10 % (0 - 15 %)
- response time	t_{90} < 100 ms
- accuracy	± 0,01 %
- resolution	0,01 %
General data:	
- weight	280 g
- dimensions (L x W x H)	150 x 100 x 55 mm
- supply voltage rechargeable batteries	4 x 1,2 V AA Ni-MH
- power intake	1,5 W
- battery charger:	
- supply voltage	230 - 240 VAC, 50 Hz
- number of loaded batteries	4 pcs
Ambient conditions:	
- humidity	0 - 100 %
- temperature	-20 - + 50 °C
- atmospheric pressure	500 - 1200 hPa

Certificates: CE 1011, ISO 13485:2016

Standard package includes:

measurement module with built-in Bluetooth transmitter and POLAR receiver and ambient pressure module, a coupler for MES DV40 pneumotachograph headpiece and built-in: sensor and digital converter of air flow, ambient temperature and humidity sensors, connected cable and air tube for gas analyzers, battery charger, 4 x AA 1,2 V rechargeable batteries, USB cable, pneumotachographs (10 pcs), large, medium and small face masks with caps and couplers, 3-liter calibration syringe, POLAR transmitter belt, backpack for measurement module, carry bag for modules and accessories, carry bag for calibration syringe, software for VO2max[Tracker] ergospirometer (works with Windows 7/8/10), manual CD.

Used patents:

- Patent 173767 Developed and patented by MES - the pneumotachograph MES DV40 headpiece for flow measurement
- Patent 195041 Developed and patented by MES - the fast coupler, for quick and easy replacement of the MES DV40 pneumotachograph headpiece
- Patent 230143 Developed and patented by MES - digital flow converter, placed directly on the MES DV40 pneumotachograph headpiece

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